Experimental Analysis of Indicated Thermal Efficiency of 4 Stroke Single Cylinder C.I Engine with blending of Mahua Oil & Diesel

[1]Chirag D. SIngal, [2]Syed F.Ahmed, [3]Mayur J. Jalanapurkar
[1]M.E Scholar[2] Professor,[3]Asst. Prof.
[1]Mechanical Department,
[1]SIRT, Bhopal, India

***Abstract* - The Purpose of this study is to improve the performance of 4 stroke single cylinder diesel engine with blending of Mahua oil and diesel. Mahua oil is obtained from the seeds of madhuca indica, a deciduous tree which can grow in semi-arid, tropical and sub-tropical areas. It grows even on rocky, sandy, dry shallow soils and tolerates water logging conditions. Mahua oil have a close properties to diesel. An experiment was conduct on 4 stroke CI engine with employing the blends of Mahua oil and diesel in respect of 5%, 10% & 15%. During an experiment readings were observed. optimum parameters for Higher Indicated thermal efficiency are 15% of mahua oil blend with diesel, 145 bar injection pressure and 1 kg load.**

***IndexTerms* - Diesel, Mahua oil , Injection pressure, Engine performance, Blends of Mahua oil & diesel, Indicated thermal efficiency**

I. INTRODUCTION

As per current situations concerned with availability of fossil fuel and increasing the demand of vehicles at point of view of transportations, it is necessary to think about it. Also it is noted that prices of petrol and diesel are continuous increases. Day by day increasing the consumption of fossil fuels like petrol and diesel, possibility makes in future that their sources will not available so more. Also today's main problem is the pollution created from vehicles. So, ours effort must be go in that direction which reduces the pollution and also find a suitable alternative for the fossil fuels.

As per current scenario, India is a diesel based economy. Diesel consumption is around five times the consumption of petrol. So, to reducing the pollution & achieve a great economical benefit, we have to find suitable alternatives for diesel engine and must be do research work on them.

Mahua oil have a similar properties of diesel. The use of non-edible vegetable oils such as Mahua oil is of significance because of the great need for replacement of diesel. Compare to other vegetable oil the mahua oil properties like cetane number and calorific values are closer to diesel. Mahua oil was procured from an oil mill. The oil was filtered to remove the impurities.The flash point of mahua oil was higher than diesel and hence it is safer to store.

Table 1 Properties of Diesel & Mahua oil

Properties (condition)	Unit	Mahua Oil	Diesel
Density	Kg/m3	872	799
C.V	Kj/kg	41000	45814
Flash Point	°C	204	85
Cetane no.		50	47
Carbon residue	%	0.46	0.30
Kinematic Viscosity @ 40°C	cSt	38.4	4.1

II- Experimental set-up & Procedure

The setup consists of single cylinder, four stroke, water cooled diesel engine. The engine is coupled to a rope brake dynamometer through a load cell. The injection point can be changed for research tests. On the upper part of plunger the adjustable screw is attached to the injector. Injection pressure is changed by rotating the adjusting screw. Control panel is involve that supply of air, fuel and cooled water. The experiment has been performed on 4 stroke single cylinder diesel engine. In this experiment, Mahua Oil used as a blend with diesel with different percentage of 5%, 10% & 15% An injection pressure was also change during an experiment. Taguchi method is used for this experiment. This method uses a special set of arrays called orthogonal arrays. These standard arrays stipulates the way of conducting the minimal number of experiments which could give the full information of all the factors that affect the performance parameter. The orthogonal arrays method lies in choosing the level combinations of the input design variables for each experiment. In this experiment, three factors and four

levels are involved with taguchi method. So, the orthogonal array becomes L16 for conduct the experiment. Three factors are included that % of Mahua oil, Injecton pressure and Load.

Table 2 Engine Specification

Engine	Single cylinder four stroke
Bore × Stroke	80 mm × 110 mm
Compression ration	18:1
Maximum Power	4.2 kw
Rated speed	1500 rpm
Capacity	650 cc

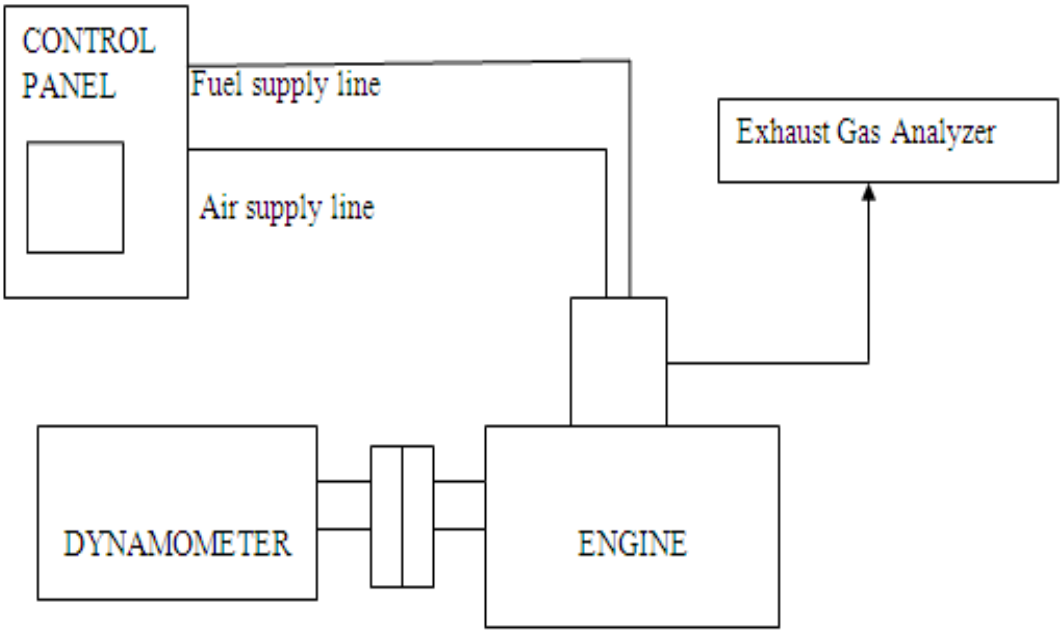

Fig. 1 Block diagram of experimental set-up

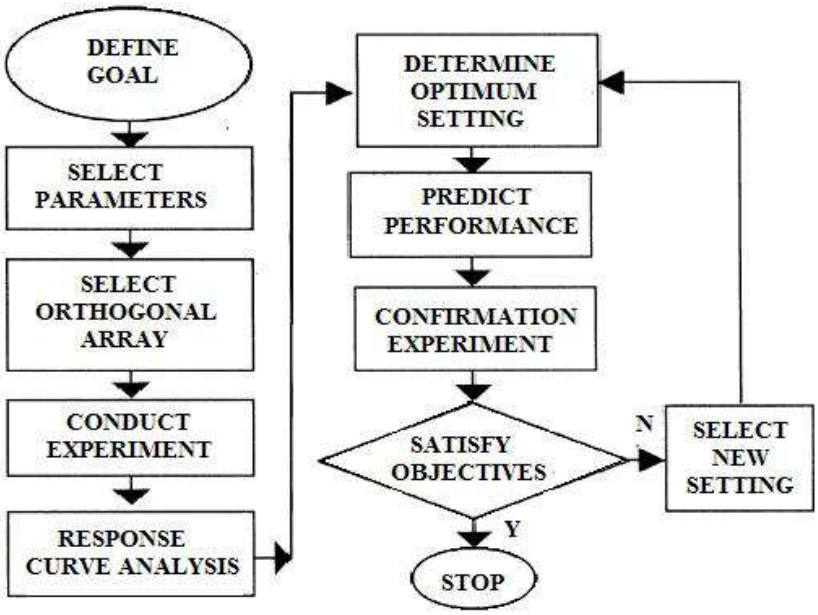

Fig. 2 Taguchi method steps

III Result Analysis

Table 3 L16 Orthogonal Array

Sr No.	% of Mahua oil	Injection pressure Bar	Load kg	Indicated thermal effi. %
1	0	145	1	9.219
2	0	160	4	5.575
3	0	190	7	5.273
4	0	210	10	5.797
5	5	145	4	10.482
6	5	160	1	11.408
7	5	190	10	9.805
8	5	210	7	9.583
9	10	145	7	15.414
10	10	160	10	14.549
11	10	190	1	19.394
12	10	210	4	10.155
13	15	145	10	15.244
14	15	160	7	15.876
15	15	190	4	10.665
16	15	210	1	21.103

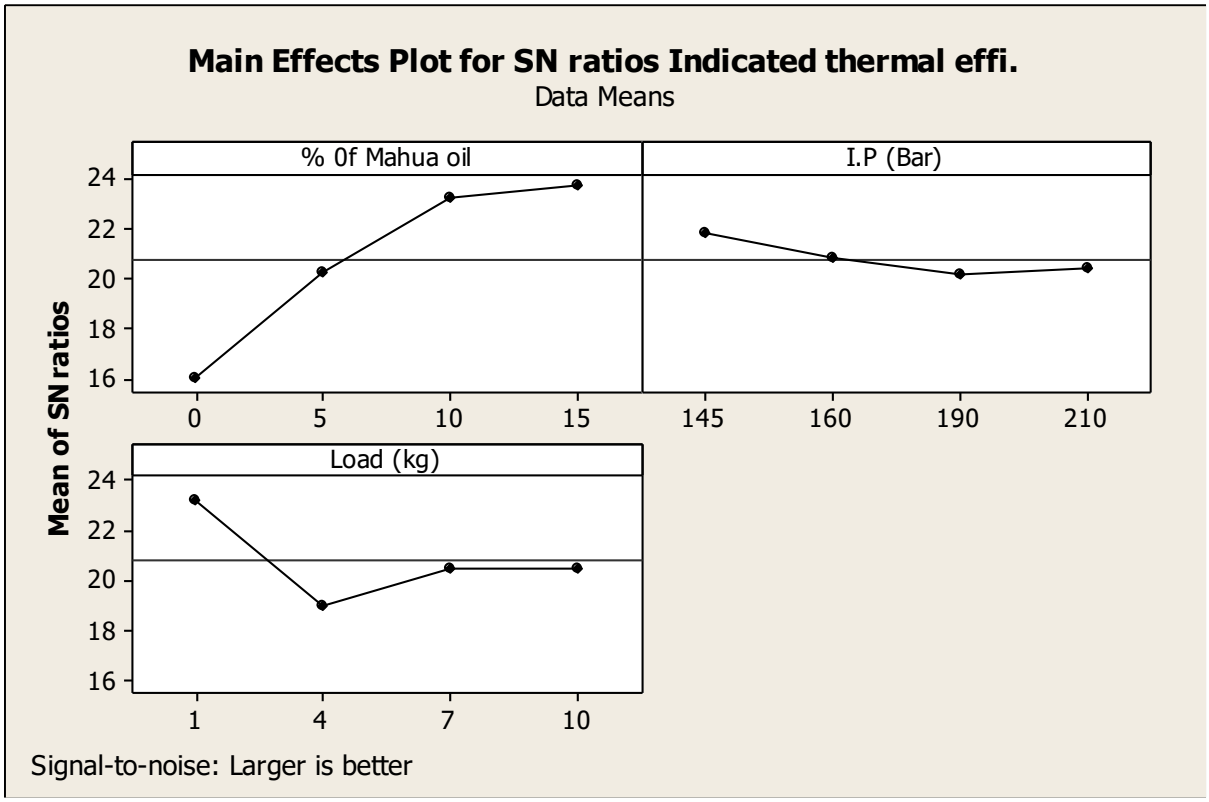

Fig. 3 Main effect plot for S/N Ratio for Indicated thermal efficiency

From above graph , it is observed that optimum parameter for Higher Indicated thermal efficiency are 15% of Mahua oil blend with diesel, 145 bar injection pressure and 1 kg load. At blending of Mahua oil with diesel Indicated thermal efficiency increase.

Table 4 Response Table

LEVEL	% OF Mahua oil	INJECTION PRESSURE (Bar)	Load (kg)
1	15.98	21.78	23.17
2	20.25	20.84	19.01
3	23.23	20.15	20.46
4	23.68	20.38	20.5
Delta	7.7	1.63	4.16
Rank	1	3	2

In the response table, Highest S/N ratio is considered. So, it is observed from response table for optimum parameters. Delta is the difference between highest and lowest value in the table. Rank indicates that , which parameters have a highest effect on Indicated thermal efficiency.

Table 5 Predict performance at optimum combination of parameters:

S/N Ratio	Indicated Thermal efficiency %	Experimented value of Indicated Thermal efficiency %
27.0606	19.8996	18.9824

IV Conclusion

From above analysis, optimum parameters for Higher Indicated thermal efficiency are 15% of Mahua oil blend with diesel, 145 bar injection pressure and 1 kg load. At blending of Mahua oil in diesel, Indicated thermal efficiency is increased , When injection pressure increased , Indicated thermal efficiency decreased.

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